Contents lists available at ScienceDirect

## **Clinical Imaging**

journal homepage: http://www.clinicalimaging.org

**Review Articles** 

# Cornual, interstitial, and angular pregnancies: clarifying the terms and a review of the literature



### Elizabeth Kagan Arleo \*, Ersilia M. DeFilippis

New York-Presbyterian/Weill Cornell, New York, NY, USA

#### ARTICLE INFO

Article history: Received 18 February 2014 Received in revised form 1 April 2014 Accepted 5 April 2014

Keywords: Cornual pregnancy Interstitial pregnancy Angular pregnancy Ectopic pregnancy 3D ultrasound

#### ABSTRACT

The terms "cornual," "interstitial," and "angular" pregnancies are used inconsistently in the literature. Some sources use "interstitial" and "cornual" synonymously, while others reserve "cornual" for gestations in bicornuate or septate uteri; others distinguish interstitial from angular pregnancy, while in practice, many physicians are unfamiliar with the latter designation. This article aims to clarify the terms and review the literature with respect to diagnosis and prognosis, with attention to the potential roles of 3D ultrasound and magnetic resonance imaging.

© 2014 Elsevier Inc. All rights reserved.

#### 1. Introduction

Ectopic pregnancy is defined as implantation of a gestation outside the endometrial cavity [1]. A ß-human chorionic gonadotropin (hCG) level above the discriminatory zone (≥2000-2200 mIU/mL International Reference Preparation) with the absence of an intrauterine pregnancy (IUP) has historically been highly suggestive of an ectopic pregnancy [1], although more recently there has been evidence against the reliability of the ß-hCG discriminatory level [2,3], making imaging assessment all the more important. The majority of ectopic pregnancies occur in the fallopian tube (95%), least commonly in the interstitial portion [1]. Dahnert's Radiology Review Manual defines an interstitial pregnancy as follows: "interstitial (cornual) ectopic=ectopic pregnancy with eccentric location in relation to the endometrium+close to the uterine serosa [1]." However, according to Williams' Obstetrics, "although used interchangeably, (these) are slightly different implantations. Cornual implantation describes those in the upper and lateral uterine cavity, whereas interstitial denotes those implanted within the proximal intramural portion of the tube" [4]. Still other sources in both the radiology and obstetrics literature reserve "cornual pregnancy" only for gestations in a bicornuate or septate uterus [5,6]. Amidst such discussion, the term "angular pregnancy" sometimes arises, defined as "implantation within the endometrium of the lateral angle of the uterus, medial to the uterotubal junction" [5]. Although angular pregnancy is a term unfamiliar to many radiologists, this deficiency

should be remedied because it is a reported clinical entity (Fig. 1). Furthermore, understanding the difference between all of these entities is clinically important because the conditions' natural histories and management differ.

The objective of this review is to clarify the terms cornual, interstitial, and angular pregnancy, and provide a scholarly analysis of the literature on this important topic for Ob/Gyn imagers. It is worthy of attention given the development of three-dimensional (3D) ultrasound (US) and magnetic resonance imaging (MRI) since this topic was last seriously considered in the literature prior to the turn of the century.

#### 2. Anatomy and nomenclature

The fallopian tubes and uterus are embryologically derived from the Müllerian ducts: the proximal segments remain unfused and develop into the fallopian tubes, whereas the distal segments fuse to give rise to the uterus and upper four-fifths of the vagina [7,8]. The fallopian tube has four named segments: (from laterally to medially) the infundibulum, ampulla, isthmus, and interstitial segments [7]. The interstitial (or intramural) segment is approximately 1–2 cm in length, traversing the muscular myometrial layer of the uterus and opening via the inner tubal ostium into the uterine cavity [9]. Thus, by strict anatomic definition, interstitial pregnancy should refer to a pregnancy in the interstitial portion of the fallopian tube. Of tubal ectopic pregnancies, 2%–4% are reported to occur in this location [7].

By 12 weeks' gestational age, the uterus demonstrates its normal morphology: fused external contour of the myometrium and triangular-shaped endometrial/uterine cavity with base directed



<sup>\*</sup> Corresponding author. New York-Presbyterian/Weill Cornell, 425 East 61st Street, 9th Floor, New York, NY 10065, USA. Tel.: +1 821 0680; fax: +1 212 821 0671.

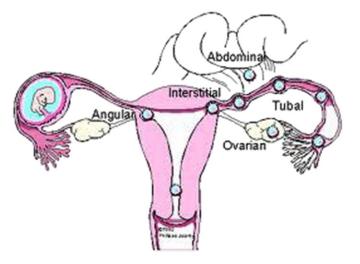


Fig. 1. Diagram of pregnancy locations [35].

cranially and apex caudally toward the cervix and vagina [8] (Fig. 2). The uterus is maintained in location by multiple ligaments, including the round ligament which crosses the fallopian tube at the uterotubal junction. Anatomically, the superior two-thirds of the uterus is the body; the inferior one-third is the cervix; and the superolateral regions of the uterine cavity where the fallopian tubes enter are the uterine horns or cornua (Latin: singular cornu, plural cornua) [9]. Accordingly, a normal uterus has two cornua, one on the right side and one on the left (Fig. 3).

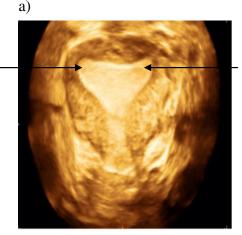
Abnormal uterine configurations, most commonly classified according to the schematization of the American Fertility Society (Fig. 4) [10], include didelphus, bicornuate, septate, and drug-eluting stent drug-related (usually T-shaped) configurations—all of which *also* have two cornua—as well as the unicornuate configuration, which may have only one cornu (right or left). Thus, by strict anatomic definition, a cornual pregnancy should refer to a pregnancy in the cornu of the uterus—i.e., in the superiolateral region of the uterine/ endometrial cavity where the fallopian tube enters—whether the uterus is normal in configuration or has a Müllerian duct anomaly.

#### 3. The confusion

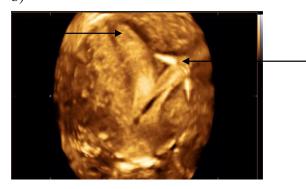
The taxonomic confusion regarding the terms cornual, interstitial and angular pregnancies appears distillable into the following three categories of issues.



**Fig. 2.** A 33-year-old woman with infertility at our institution. This normal hysterosalpingogram demonstrates the triangular-shaped uterine/endometrial cavity, opacification of the thin fallopian tubes, and normal bilateral intraperitoneal spillage of contrast into the pelvic cavity.



b)



**Fig. 3.** Coronal 3D **US** images from our institution demonstrating the two uterine cornua/horns (arrows) in a normal uterus (a) and a uterus with a Müllerian duct anomaly (b) (septate); the latter demonstrates an echogenic polyp on the right and shadowing intrauterine device on the left.

First, as others have pointed out as well, the terms "interstitial" and "cornual" pregnancy are frequently used synonymously. For example, Lin et al. [11] in *RadioGraphics* (2008) wrote, "Cornual pregnancy... is often used interchangeably with interstitial pregnancy." Similarly, Moawad et al. [12] in *Am J Obstet Gynecol* (2010) wrote, "Interstitial pregnancy sometimes is mistakenly referred to as cornual pregnancy, and frequently confused with angular pregnancy." The consequence of synonymous use of the terms "interstitial" and "cornual" pregnancy is a blurring of the distinction between the two entities.

Second, the term "cornual" pregnancy is sometimes but not always applied just to pregnancies in bicornuate or septate uteri. Reports of cornual pregnancy date back to 1952 by Johnston and Moir [6], who defined a cornual pregnancy as being "in one horn of a bicornuate uterus, or, by extension of meaning, in one lateral half of a uterus of bifid tendency." By 1982, however, Maher and Grimwade [13] write that, in practice, many Ob/Gyns also consider a pregnancy located in the cornual region of a normal uterus to be a cornual pregnancy as well: "we agree that there is much confusion over the terms interstitial, cornual and angular pregnancy, [however] the fact remains that any pregnancy occurring in the cornual region of a normal uterus is still referred to by many gynecologists, if not the majority, as a 'cornual pregnancy'" Although many papers in reputable Ob/Gyn journals continue to use Johnston's original definition of a cornual pregnancy as one occurring in a congenitally abnormal uterus [14,15], the current version of Williams' Obstetrics supports Maher and Grimwade, defining cornual implantation as occurring in the upper and lateral uterine cavity of an anatomically normal uterus [4]. The consequence of this dual-or "loose"-use of the word cornual is imprecision and confusion. Thus, putting aside the fact that common practices can be hard to change, at the very least,

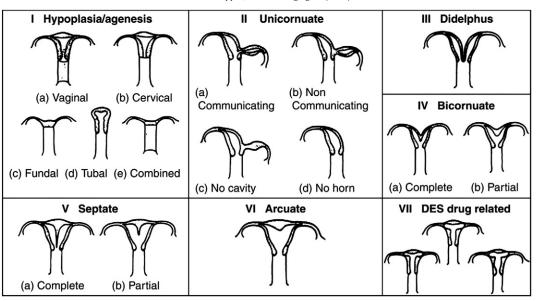


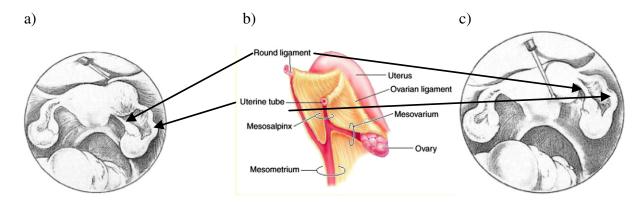
Fig. 4. American Fertility Society classification of Müllerian duct anomalies [10].

consideration might be given to either dropping the term "cornual pregnancy" altogether or limiting its usage to a pregnancy in a horn of an anomalous uterus (Johnston's original definition); either would also help prevent the first issue (synonymous use of "cornual" and "interstitial") as well.

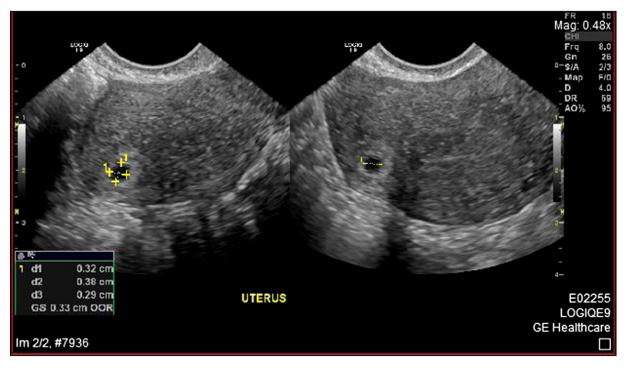
Third, there are relatively few papers in the literature that mention angular pregnancy more than just in passing and there are less than 100 cases of angular pregnancy ever reported in the literature [4,14–22]. The consequence of this dearth of publications is often physician puzzlement when the term angular pregnancy is encountered, accompanied by questioning of its clinical validity despite the fact that it appears in premier journals of both specialties by authors from major U.S. institutions (Mallinckrodt [5], University of Texas [16]). Angular pregnancy was first defined in 1898 by the American obstetrician Howard Kelly as "implantation of the embryo just medial to the uterotubal junction, in the lateral angle of the uterine cavity" [17]. Angular pregnancy is distinguished from interstitial pregnancy, wrote Jansen and Elliot [18] years later, by its position in relation to the round ligament as seen at surgery: "The lateral uterine enlargement of an angular pregnancy displaces the round ligament reflection upward and outward. The swelling of an interstitial tubal pregnancy is lateral to the round ligament" (Fig. 5). Although there is no absolute anatomic boundary distinguishing an angular pregnancy from a normal one, the closer a gestation implants to the internal uterine ostium of the fallopian tube, the greater likelihood of visual asymmetry and a symptomatic patient as the pregnancy progresses [18]. The reason that many radiologists may not be familiar with the term angular pregnancy is that in the past, as Jansen and Elliot [19] wrote in a letter to the editor in 1983, the distinction between angular and interstitial pregnancy was "made at laparoscopy; it cannot be made ultrasonographically." However, with significant interval developments in imaging since that time this may no longer be the case, and this review aims not only to directly address this possibility but also to increase radiologists' familiarity with the term angular pregnancy.

#### 4. Diagnostic modalities and findings

Having discussed three factors contributing to the taxonomic confusion of the terms cornual, interstitial, and angular pregnancy, the diagnostic confusion surrounding these entities is now addressed. The latter probably stems from the fact that originally, these terms were described by their operative appearance, relying on the



**Fig. 5.** (a) Posterior view of the uterus at laparoscopy demonstrating an *interstitial ectopic pregnancy* (implantation of the embryo in the interstitial portion of the fallopian tube). The gestational swelling is *lateral to* the round ligament, so it does *not* displace it [18]. (b) Diagram demonstrating a side view of the uterus (anterior surface of the uterine body facing left), fallopian tube, and ligaments [36]. (c) Posterior view of the uterus at laparoscopy demonstrating an *angular pregnancy* (implantation of the embryo just medial to the uterotubal junction, in the lateral angle of the uterine cavity medial to the round ligament) [18]. The gestational swelling *displaces* the round ligament superiorly and laterally.



**Fig. 6.** A 32-year-old pregnant woman with right pelvic pain. Grayscale endovaginal images of the uterus demonstrating criteria of Timor-Tritsch et al. [20] to diagnose an interstitial pregnancy, including (1) an empty uterine cavity, (2) a chorionic sac seen separately from the most lateral edge of the uterine cavity, and (3) a thin myometrial layer surrounding the chorionic sac. Case courtesy of Meghan Doherty, MD, New York–Presbyterian Hospital, Downtown, 2012.

appearance of the external contour of the uterus. However, now with markedly improved sonographic techniques and MRI, these terms can now be described by their imaging appearance, relying on the appearance of the now visualized intrauterine findings.

#### 4.1. Laparoscopy and hysteroscopy

Traditionally, laparoscopy was the gold standard for the diagnosis of ectopic pregnancy. However, currently, the widespread availability of transvaginal US and rapid assays for serum β-hCG has largely made the use of laparoscopy for *diagnostic* purposes an obsolete practice. Hysteroscopy, direct visual inspection of the uterine cavity via the cervix with an endoscope and CO<sub>2</sub> gas insufflation, although somewhat less invasive, is less commonly used diagnostically for similar reasons. On hysteroscopy, an angular pregnancy would be visualized in the superior lateral aspect of the uterine cavity, whereas an early interstitial pregnancy sequestered in the fallopian tube (unless protruding out) would not be visualized. With laparoscopy, the major advantage (in addition to the fact that it can be therapeutic) is direct visualization of the uterus and fallopian tubes, allowing an angular pregnancy to be distinguished from interstitial pregnancy by its position in relation to the round ligament. In 1981, almost 90 years after the term, angular pregnancy was first coined by Kelly, and with the addition of laparoscopy, the specific diagnostic criteria proposed by Jansen and Elliot for angular pregnancy included the following: "1) Clinical presentation with painful asymmetric enlargement of the uterus, followed by abortion or vaginal delivery; 2) Directly observed lateral distension of the uterus, with or without rupture, accompanied by displacement of the round ligament reflection laterally; 3) Retention of the placenta in the uterine angle" [18]. Now in 2013, over 30 years after Jansen and Elliot proposed the above criteria, the specific diagnostic imaging criteria for angular pregnancy remain to be defined-while suggestions based on literature review could be made, they would not be evidencebased because no clinical studies assessing potential criteria have been performed yet.

#### 4.2. Ultrasound

According to the American College of Radiology (ACR) Appropriateness Criteria [25], the first-line imaging modality in the evaluation of patients with a positive urine or serum pregnancy test presenting with first-trimester vaginal bleeding is pelvic US, utilizing both a transabdominal and transvaginal approach. Although **US** is highly operator-dependent, its advantages include its portability, lack of ionizing radiation, relatively inexpensive cost, and the fact that it is a real-time dynamic examination.

In 1992, three **US** criteria were proposed by Timor-Tritsch et al. [20] to diagnose an interstitial pregnancy (specificity 88%–93%, sensitivity 40%): (1) an empty uterine cavity, (2) a chorionic sac separately (>1 cm) from the lateral edge of the uterine cavity, and (3) a thin (<5 mm) myometrial layer surrounding the chorionic sac (Fig. 6). However, uterine leiomyomas (Fig. 7), contractions, or anomalies may cause a normal pregnancy to appear eccentric in location and therefore be confused with an interstitial pregnancy [1]. An unintended consequence of such a "false-positive" interpretation could be unnecessary termination. A year later, in 1993, Ackerman et al. [21] described the "interstitial line sign" (sensitivity of 80%, specificity of 98% in diagnosing interstitial pregnancy) (Fig. 8): an echogenic line in the cornual region of the uterus bordering the midportion of the gestational sac, thought to represent the interstitial portion of the tube in small interstitial pregnancies and the endometrium in larger pregnancies [1]. The key imaging finding to highlight regarding interstitial pregnancy is that it lies outside the endometrium (extraendometrial). Recalling the definition of ectopic pregnancy which opened this paper-implantation of a gestation outside the endometrial cavity [1]-this is what makes an interstitial pregnancy an ectopic. In contrast, the key imaging finding to highlight regarding angular pregnancy is that it lies within the endometrium (intraendometrial), and therefore, it is not an ectopic pregnancy (Table 1).

Since all early IUPs implant slightly eccentrically within the uterine cavity—due to the fact that they embed in the decidua on one side or the other—how, then, to distinguish between an angular pregnancy and a normal one, and furthermore, why should an Ob imager care?



**Fig. 7.** Uterine leiomyomas may cause a normal pregnancy to appear eccentric in location and therefore confused with an interstitial pregnancy. (a) 2D transvaginal grayscale **US** image of an early first-trimester pregnancy demonstrates a gestational sac (with surrounding echogenic halo thought to be due to decidual reaction) eccentrically located in the left superior lateral aspect of the uterus; although the surrounding myometrial layer is >5 mm, in the impression, the interpreting radiologist raised the possibility of a "cornual pregnancy." (b) MRI obtained for further characterization demonstrates on this axial T2-weighted images (W 2744, L 1372) a right-sided myoma (arrow), probably accounting for the leftward appearance of the gestational sac on **US**, but a normal, centrally located IUP in a uterus of normal configuration (c); this pregnancy went to term, yielding a normal male infant.

The latter question will be addressed more fully in the Prognosis and Management section below, but in brief, an Ob imager should care if a pregnancy is angular because it has associated increased risks. In terms of the former question, an angular pregnancy is on a spectrum between normal (centrally located IUP) and abnormal (interstitial): in cases of initial uncertainty where along this spectrum an early IUP is, short-term interval follow-up US, even of just a few days, may answer the question, with most pregnancies declaring themselves to be normal appearing in location. In cases of persistent uncertainty-although not currently the standard of care or yet adequately studied-3D US could be considered, if available, for further characterization. As Fig. 9 demonstrates, an endovaginal coronal 3D US image can show the full extent of the echogenic endometrial cavity in one plane next to the relatively hypoechoic myometrium arguably better than any twodimensional (2D) plane can, potentially facilitating the distinction between an interstitial ectopic (extraendometrial) and an angular (intraendometrial) pregnancy. Specifically, both the radiology and obstetrical literature have reported that 3D multiplanar sonography may provide increased sensitivity because of better visualization of the structure of the endometrial canal [22,23], and it has been reported to be particularly helpful in diagnosing interstitial pregnancy in cases where 2D USs were "negative" or inconclusive [24]. Furthermore, 3D US can reconstruct and reformat stored data to

provide additional views, particularly of the relationship of the gestation to the uterine cavity, which may not otherwise be available [23]. However, if 3D **US** cannot resolve the issue or is unavailable, then MRI (Figs. 7 and 10) could be considered for further characterization, as discussed below.

#### 4.3. MRI

According to ACR Appropriateness Criteria, "while US is usually sufficient for the diagnosis of unusually located ectopic pregnancies, there are increasing reports of using MRI to aid in these diagnoses [25]." The technique should be noncontrast since gadolinium crosses the placenta and is contraindicated in pregnancy [26,27]. Multiplanar T2-weighted sequences demonstrate the T2 hyperintense endometrium in contrast to the lower-signal-intensity myometrium (Fig. 7), and a T1-weighted sequence is helpful for the detection of blood [5,28]. The round ligament and fallopian tube are easier to visualize in the presence of free fluid [29], which is increased in quantity and complexity in cases of rupture.

On magnetic resonance, both an interstitial ectopic and an angular pregnancy may appear as a heterogeneous mass with intermediate to high T2 hyperintensity (Fig. 7), with the size depending on gestational age [5,30]. In terms of location, if a superior lateral uterine mass is

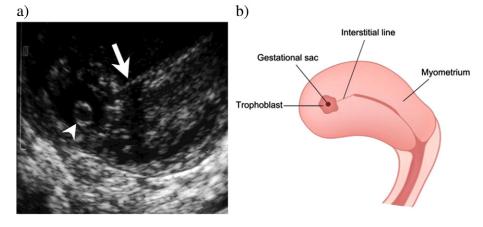


Fig. 8. Ackerman's interstitial line sign for interstitial pregnancy. (a) Transvaginal grayscale US image, oblique axis, demonstrating a gestational sac with yolk sac (arrowhead) located in the interstitial portion of the fallopian tube as evidenced by the interstitial line sign (arrow) [37], with (b) correlating diagram (reproduced with permission) [11].

predominantly surrounded by myometrium (relatively T2 hypointense) and/or an intact junctional zone (extremely T2 hypointense) is visualized between the mass and the T2 bright endometrium, then this supports the diagnosis of an interstitial pregnancy [5,28]. In contrast, if a superior lateral uterine mass is instead predominantly surrounded by T2 hyperintense endometrium, then this may suggest an angular pregnancy. Since the latter can be difficult to distinguish from a normal pregnancy, as previously discussed, thinning of the adjacent myometrium and/or placental invasion into the myometrium may be additional findings supporting the impression of an angular pregnancy [5].

#### 5. Prognosis and management

The purpose of this section of this article is to review interstitial and angular pregnancy with respect to natural history and the management options available. "Understanding the distinctions among these entities can have important clinical implications," write Parker et al. [5], "because management and outcomes differ among them."

#### 5.1. Interstitial pregnancy

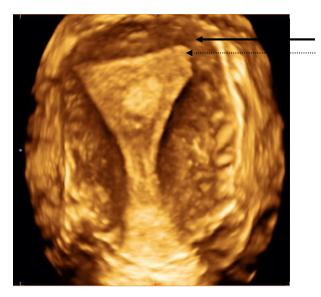
With the exceedingly rare exception of six case reports of interstitial pregnancies that have achieved fetal viability and have been published in the literature [16], an interstitial ectopic pregnancy is considered nonviable because it generally cannot result in a liveborn baby [3]. Although increased distensibility of this segment of the fallopian tube can lead to presentation as late as the 16th week of gestation [1], if the pregnancy continues to progress, then rupture is almost universal, as is death to the fetus and potentially the mother [1]. Thus, a ruptured interstitial ectopic pregnancy is a surgical emergency: it has a twofold mortality compared with other tubal ectopic pregnancies due to the risk of hemorrhage from uterine arteries and veins [1]. Surgical treatment options include laparotomy, laparoscopy, cornuostomy, salpingotomy, laparoscopic cornual resection, cornual wedge resection, mini-cornual excision, and hysterectomy [13].

An unruptured interstitial ectopic pregnancy in a symptomatic but hemodynamically stable patient is an urgent, but not emergent, condition usually managed with termination [3]. Medical options include methotrexate (most commonly administered intramuscularly) [12,31,32] and image-guided options include **US**-guided percutaneous administration of methotrexate or potassium chloride into the ectopic gestation, with the former treatment working better the earlier the gestation. Alternatively, an unruptured asymptomatic interstitial ectopic pregnancy with declining levels of serum  $\beta$ -hCG indicating spontaneous abortion in progress might be a candidate for watchful waiting [31,33].

#### Table 1

Summary of the differences between interstitial (I) and angular (A) pregnancy

	Interstitial	Angular
Implantation location	Fallopian tube (interstitial segment)	Endometrial cavity (superior lateral aspect, just medial to the uterotubal junction)
Relationship to the round ligament	Lateral	Medial
Relationship to the endometrium	Extraendometrial	Intraendometrial
Ectopic?	Yes	No
Prognosis-fetus	Nonviable [3]	Uncertain viability [3]
Prognosis-mother	Significant maternal morbidity and mortality if progresses to rupture	Increased risk of uterine rupture
Imaging findings	Interstitial line sign=thin echogenic line extending directly	Gestational sac primarily surrounded by
	up to the center of ectopic pregnancy	endometrium with adjacent thicker myometrial layer
	Gestational sac seen separately from the most lateral edge	
	of the uterine cavity, with myometrium between	
	sac and endometrial cavity	
	Thinning of myometrial mantle to $\leq 5$ mm thick	
Imaging		



**Fig. 9.** Grayscale endovaginal 3D US, oblique-coronal plane, demonstrating an echogenic polyp located centrally within central endometrial cavity where a normal gestation should implant. In contrast, the tip of the thicker solid arrow indicates where an interstitial ectopic pregnancy would be located, and the tip of the thinner dashed arrow indicates where an angular pregnancy would be located.

#### 5.2. Angular pregnancy

"This distinction (between interstitial and angular pregnancy) is important," Parker et al. further point out in their 2012 *RadioGraphics* review "because angular pregnancies can sometime be carried to term" due to their intrauterine, intraendometrial location [5]. In their recent benchmark *New England Journal of Medicine* article, Doubilet et al, as part of a Society of Radiologists in Ultrasound Multispecialty Panel, set forth that "a pregnancy is viable if it can possibly result in a live-born baby" [3]. By this definition, an angular pregnancy is a potentially viable one.

In terms of outcomes, the largest published meta-analysis to date describes 39 cases of angular pregnancy (inclusion criteria: cases that satisfy either of the first two criteria of Jansen and Elliot [18] delineated on the ninth page of this article) and reports a 38.5% rate of spontaneous or missed abortion. Furthermore, the authors offer that "a crude estimate of the chance of an angular pregnancy causing an otherwise normal uterus to rupture would be 13.6%" [18]. Given the seriousness of the latter, angular pregnancy management considerations might potentially include therapeutic abortion. Alternatively, depending on the degree of desirability of the pregnancy and the risk aversity levels of the physician and patient, "watchful waiting" may be elected. Since patients with angular pregnancy may present with severe pain-in the past, necessitating surgery to exclude other etiologies including interstitial ectopic pregnancy [34]-management may, in such a scenario, consist of closer clinical and sonographic follow-up to ensure that the angular location is responsible for the patient's pain; if this is the case, the discomfort usually subsides during the second trimester [15].

#### 6. Conclusions

The terms "cornual," "interstitial," and "angular" pregnancies have been used inconsistently throughout the medical literature for decades. Although this review has its limitations—including lack of 3D US images of angular and interstitial pregnancies—the authors nevertheless believe that this review contributes to the literature by clarifying the terms and elucidating their salient features (Table 1). Future research is needed to determine whether 3D **US** and/or MRI can reliably distinguish interstitial from angular pregnancies. Additionally, putting aside the fact that common practices can be hard to change, at the very least,

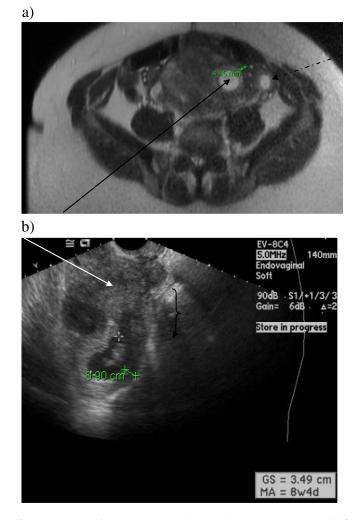


Fig. 10. A 39-year-old pregnant woman with uterine leiomyomas presents with left lower quadrant pain to our institution. Two early first-trimester USs (not shown) were considered unremarkable in terms of gestation sac location, possibly due to limitations of the presence of multiple uterine leiomyomas. (a) MRI obtained at 7 weeks 0 days due to persistent pain (axial single-shot fast spin-echo image shown here with TR 2800, TE 87.12, flip 90) was read as "a single gestational sac (long solid arrow) is present in the left uterine cornua... Myometrium overlying the gestational sac measures as little as 3 mm in thickness. A left ovarian corpus luteum cyst (dashed arrow) is again noted .... Findings suspicious for left cornual ectopic pregnancy." Close interval follow-up was recommended. (b) US obtained 17 days later at 8 weeks 4 days' gestational age demonstrates, on this grayscale longitudinal image, a gestational sac eccentrically located in the superior lateral aspect of the endometrial canal, primarily surrounded by echogenic endometrium, and surrounded by thicker myometrial layer (>5 mm), suspicious for angular pregnancy (arrow=myoma). The patient elected termination of the pregnancy due to multiple medical problems and suction dilation and curettage was performed uneventfully in the operating room. This, in conjunction with surgical pathology demonstrating immature chorionic villi, implantation site and gestational endometrium, support an intraendometrial location; MRI and US imaging support a superior lateral location; taken together, these findings are suspicious for an angular pregnancy.

consideration might be given in the future to either dropping the term "cornual pregnancy" altogether or limiting its usage to a pregnancy in a horn of an anomalous uterus.

#### References

- Dahnert W. Radiology review manual. 6th ed. Philadelphia: Lippincott, Williams & Wilkins; 2007.
- [2] Doubilet PM, Benson CB. Further evidence against the reliability of the human chorionic gonadotropin discriminatory level. J Ultrasound Med 2011:30:1637–42.
- [3] Doubilet PM, Benson CB, Bourne T, Blaivas M. Diagnostic criteria for nonviable pregnancy early in the first trimester. N Engl J Med 2013;369:1443–51.
- [4] Cunningham FCLK, Bloom SL, Hauth JC, Rouse DJ, Spong CY. Williams obstetrics. 23rd ed. New York: McGraw-Hill; 2009.

- [5] Parker RA, Yano M, Tai AW, Friedman M, Narra VR, Menias CO. MR imaging findings of ectopic pregnancy: a pictorial review. Radiographics 2012;32:1445–60 [discussion 1460–1442].
- [6] Johnston LW, Moir JC. A case of angular pregnancy complicated by gas-gangrene infection of the uterus. J Obstet Gynaecol Br Emp 1952;59:85–7.
- [7] Eddy CA, Pauerstein CJ. Anatomy and physiology of the fallopian tube. Clin Obstet Gynecol 1980;23:1177–93.
- [8] Troiano RN, McCarthy SM. Müllerian duct anomalies: imaging and clinical issues. Radiology 2004;233:19–34.
- [9] Moore KL, Dalley Arthur F, Agur Anne M. Clinically oriented anatomy. 6th ed. Baltimore, MD: Lippincott, Williams, & Wilkins; 2010.
- [10] The American Fertility Society classifications of adnexal adhesions, distal tubal occlusion, tubal occlusion secondary to tubal ligation, tubal pregnancies, Müllerian anomalies and intrauterine adhesions. Fertil Steril 1988;49:944–55.
- [11] Lin EP, Bhatt S, Dogra VS. Diagnostic clues to ectopic pregnancy. Radiographics 2008;28:1661–71.
- [12] Moawad NS, Mahajan ST, Moniz MH, Taylor SE, Hurd WW. Current diagnosis and treatment of interstitial pregnancy. Am J Obstet Gynecol 2010;202:15–29.
- [13] Maher PJ, Grimwade JC. Cornual pregnancy–diagnosis before rupture a report of 2 cases. Aust N Z J Obstet Gynaecol 1982;22:172–4.
- [14] Lau S, Tulandi T. Conservative medical and surgical management of interstitial ectopic pregnancy. Fertil Steril 1999;72:207–15.
- [15] Alves JA, Alves NG, Alencar Junior CA, Feitosa FE, da Silva Costa F. Term angular pregnancy: successful expectant management. J Obstet Gynaecol Res 2011;37:641–4.
- [16] Hill AJ, Van Winden KR, Cook CR. A true cornual (interstitial) pregnancy resulting in a viable fetus. Obstet Gynecol 2013;121:427–30.
- [17] Kelly H. Operative gynaecology. New York: Appleton; 1898.
- [18] Jansen RP, Elliott PM. Angular intrauterine pregnancy. Obstet Gynecol 1981;58:167-75.
- [19] Jansen R, Elliott P. Angular and interstitial pregnancies should not be called "cornual" [letter]. Aust NZ J Obstet Gynaecol 1983;23:123–4.
- [20] Timor-Tritsch IE, Monteagudo A, Matera C, Veit CR. Sonographic evolution of cornual pregnancies treated without surgery. Obstet Gynecol 1992;79:1044–9.

- [21] Ackerman TE, Levi CS, Dashefsky SM, Holt SC, Lindsay DJ. Interstitial line: sonographic finding in interstitial (cornual) ectopic pregnancy. Radiology 1993;189:83–7.
- [22] Asch E, Levine D, Robens J. Cornual ectopic pregnancy of dichorionic diamniotic twins, with one live fetus and co-twin demise. Ultrasound Q 2012;28:189–91.
- [23] Araujo Junior E, Zanforlin Filho SM, Pires CR, et al. Three-dimensional transvaginal sonographic diagnosis of early and asymptomatic interstitial pregnancy. Arch Gynecol Obstet 2007;275:207–10.
- [24] Izquierdo LA, Nicholas MC. Three-dimensional transvaginal sonography of interstitial pregnancy. J Clin Ultrasound 2003;31:484-7.
- [25] (ACR) ACoR ACR Appropriateness Criteria on First Trimester Bleeding. http://www.acr. org/~/media/ACR/Documents/AppCriteria/Diagnostic/FirstTrimesterBleeding.pdf.
- [26] Garcia-Bournissen F, Shrim A, Koren G. Safety of gadolinium during pregnancy. Can Fam Physician 2006;52:309–10.
- [27] Birchard KR, Brown MA, Hyslop WB, Firat Z, Semelka RC. MRI of acute abdominal and pelvic pain in pregnant patients. AJR Am J Roentgenol 2005;184:452–8.
   [28] Filhastre M, Dechaud H, Lesnik A, Taourel P. Interstitial pregnancy: role of
- MRI. Eur Radiol 2005;15:93–5. [29] Perlman S, Hertweck P, Fallat ME. Paratubal and tubal abnormalities. Semin
- Pediatr Surg 2005;14:124–34.
  [30] Takeuchi K, Yamada T, Oomori S, Ideta K, Moriyama T, Maruo T. Comparison of magnetic resonance imaging and ultrasonography in the early diagnosis of interstitial pregnancy. J Reprod Med 1999;44:265–8.
- [31] Jermy K, Thomas J, Doo A, Bourne T. The conservative management of interstitial pregnancy. BJOG 2004;111:1283–8.
- [32] Levine D. Ectopic pregnancy. Radiology 2007;245:385-97.
- [33] Stiller RJ, de Regt RH. Prenatal diagnosis of angular pregnancy. J Clin Ultrasound 1991;19:374-6.
- [34] Tarim E, Ulusan S, Kilicdag E, Yildirim T, Bagis T, Kuscu E. Angular pregnancy. J Obstet Gynaecol Res 2004;30:377–9.
- [35] Ps B, Hk C. Angular ectopic pregnancy presenting as rupture of lateral wall of the uterus. J Hum Reprod Sci 2008;1:33–4.
- [36] Dorland's Illustrated Medical Dictionary. 31st Edition. Elsevier; 2007.
- [37] Bhatt S, Ghazale H, Dogra VS. Sonographic evaluation of ectopic pregnancy. Radiol Clin North Am 2007;45:549–60.